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THE ROLE OF OPERATORS' EXPECTATIONS IN FARM ADJUSTMENT

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THE ROLE OF OPERATORS' EXPECTATIONS IN FARM ADJUSTMENT

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SUMMARY

1. The data for this bulletin were obtained by interviewing farmers in nine West-Central Ohio counties during the 1955-60 period. Information was obtained each year from thirty-five 160-acre operators and thirty-five 320-acre operators.
2. The general findings in this study indicate that the sample operators' preproduction expectations of product prices and crop yields do not conform closely to the prices and yields realized during the year. Operators' expectations of acreages to be planted to each crop and numbers of livestock to be sold were consistent with actual acreages planted and numbers actually sold.
3. Analysis of data indicated that the sample operators do not appear to rely heavily on any particular price-data series in making preproduction price predictions for the coming year. They do, however, recognize seasonal price patterns in their predictions.
4. Irregular field size, temporary rotation changes, and going into or out of acreage allotment were the main reasons given by operators for crop acreage changes from the preceding year. The operators attributed differences between expected and actual crop yields primarily to weather conditions.
5. Most operators explained differences between expected and actual product prices as due to their own error in predicting total national production. Some operators blamed inferior quality of product.
6. Operators tended to base their yield and livestock birth rate expectations for the coming year on their past year's experience.
7. From our tests, we concluded that good price predictors in one year are not necessarily good price predictors in any other year; that good price predictors for one farm product are not necessarily good predictors for other farm products; and that good price prediction is not significantly associated with good prediction of crop acreage, crop yields, or number of hogs to be sold.
8. The sample farmers do not seem to adjust their number of spring litters to their expected butcher hog prices for the following fall.

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9. Investigation of the effects of various nonprice factors on operators' decisions suggests that nonprice influences may be more important than moderate product price changes in causing farmers to adjust, or not adjust, production.

INTRODUCTION

This study deals with farm operators' price, yield, and acreage expectations at the beginning of the production year, and the effect of these expectations on farm organization and operation during the year. We wanted answers to such questions as:

1. What factors are related to farmers' price and yield expectations?
2. How accurate are farmers, as a group, in predicting the prices and yields they will receive and the quantity of each product they will sell during the year?
3. How closely do farmers adjust their production and farm organization to their price expectations for the coming year?

Identification and measurement of stable relationships between farmers' expectations and their performance would be useful in the derivation of predictive production response equations and thus would facilitate development of agricultural programs and policies.

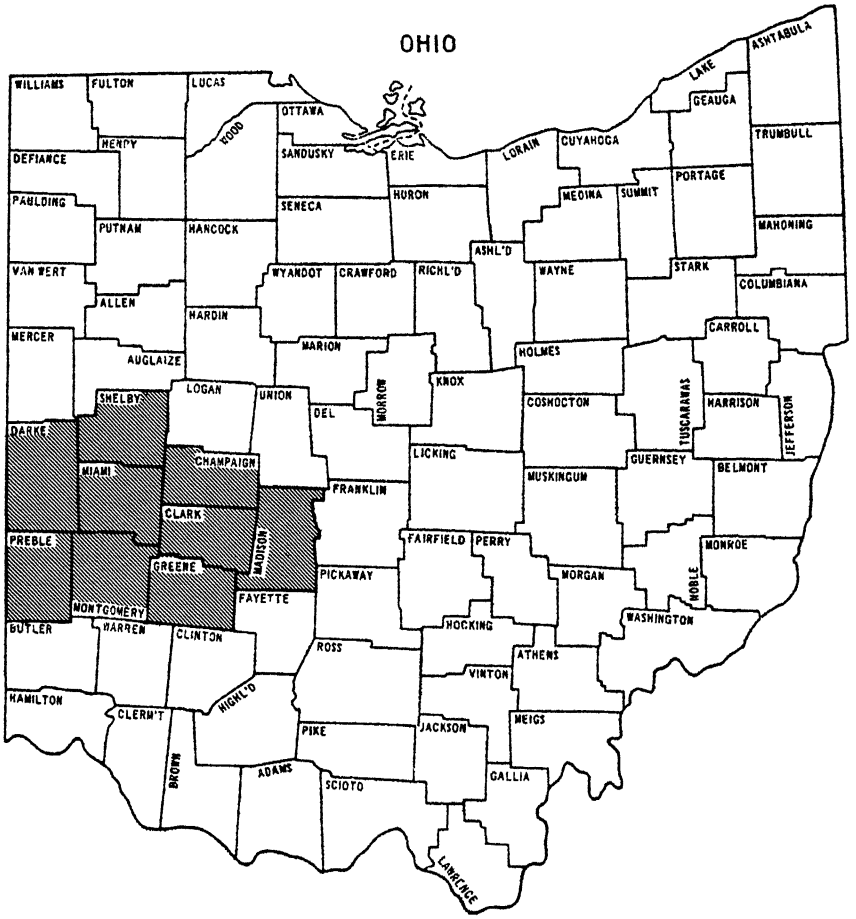
Description of the Source Project and the Sample Area

In the spring of 1956, the Ohio Agricultural Experiment Station and the Farm Production Economics Division of the Economic Research Service, United States Department of Agriculture, initiated a co-operative study of adjustment possibilities on farms in a 9-county area of West-Central Ohio, (see figure 1). A random sample of one-hundred-fifty 160 acre farms was drawn in 1956, and the following year, one-hundred-twenty 320-acre farms were also randomly selected.[1] The operators were visited and comprehensive information obtained about the organization and operation of their farms. A representative subsample of 35 farms was drawn from each of the two size groups. Operators of these farms were then interviewed each subsequent March through 1960.

The topography of the project area varies from nearly flat to sharply rolling, with the gently rolling Miami brown silt loam and clay loam

[1]The "160-acre" farms are those drawn from a 140 to 180 acre range, whereas farms in the "320-acre" group actually vary between 270 and 370 acres. These samples farms are all owner-operated units.

Fig. 1.—Counties Included in Project



soils predominant, Rainfall averages about 38 inches per year. Hog, dairy, and general livestock farms are most numerous but there are some cash grain farms. Beef cow-calf, sheep, and poultry operations are supplemental enterprises on some farms, and a few operators derive a major share of gross returns from fattening feeder cattle. Crop rotations vary from corn-small grain-meadow-meadow to corn-corn-small grain-meadow, depending generally upon topography and intensity and type of livestock production.

Procedure

Each sample operator was asked, in March, what prices he expected to receive for the products he intended to sell during the year. He was also asked in what month he expected to sell, his expected acreages of various crops, and the yields and livestock production rates he anticipated.

To discover whether or not real differences existed between these farmers' expectations and their subsequent realized prices and production, the samples were tested for significance of the differences between the expected values and corresponding realized values. This was done by paired difference comparison techniques in which two group means were tested for statistical significance.

Correlation methods were used to isolate various relationships. In some instances, tabular and graphic analyses were used where directive indications were more important than were mathematical descriptions. Linear programming was used to derive farm organizations which were economically optimum in the use of the farm's available resources.

WHAT FACTORS ARE RELATED TO FARMERS' PRICE AND YIELD EXPECTATIONS?

In this question we were wondering by what processes and with what help an operator decided which predictive value of a given series of values possessed the greatest probability of occurrence. We tried to determine what sources of information, what experience, and what noneconomic forces were used by operators in forming their pre-production period expectations.

Correlation of Expected Prices With Various Hog Price Series

The first investigation consisted of a series of correlations to attempt to isolate relationship of operators' expected selling prices with some other established price series. During each annual visit in March the enumerator recorded the price each operator expected to receive for his hogs when sold in the fall. These expected prices were correlated with the following factors: (1) actual price received in the fall; (2) outlook prediction of fall hog prices by Ohio State University price forecasters; (3) actual hog prices the previous fall; (4) current hog prices at time expected price was given; and (5) supply of hogs the previous fall. This was done for the 160-acre and the 320-acre farms for each year of data.[2] The results of the correlations are shown in Appendices A-1 and A-2.

[2]Data were obtained for 1956, 1957, 1958, and 1959 from the 160-acre operators but only for 1957, 1958, and 1959 from the 320-acre operators.

A positive and significant[3] correlation was found between expected fall hog prices and actual prices in 1958 and 1959 for both farm-size groups, and also in 1956 for the 160-acre farms. No significant correlation existed in 1957 and 1960. This indicates that the farmers correctly predicted trend of fall hog prices in about half the years studied. Their accuracy as to level of prices will be discussed in a later section.

Other correlations indicated that in 1958 and 1959 the hog prices expected by the 160-acre operators were associated with the current price of hogs at the time the operators reported their expected prices to the enumerator.[4] The outlook-price variable was significantly related to expected prices in 1958 but in no other year. The previous-year supply series correlated significantly with expected price only in 1958. Our conclusion must be that the 160-acre operators, as a group, do not rely exclusively on any of the price series included in our correlations when making their estimates of hog prices for the following fall.

The price series of the previous year most nearly followed the trend of actual fall prices. These two series were positively and significantly correlated in 1957, 1958, and 1959.[5] Thus, the 160-acre farm operators would have followed the market upswings and downswings more closely during the period studied had they simply based their estimates on the seasonal price pattern of the previous year. Figure 2 shows actual prices, 160-acre operators' expected prices, and outlook prediction prices for market hogs plotted for August through December for the years 1956 through 1960.

The same analysis was applied to expectations of the 320-acre farm operators. These operators seemed to follow outlook predictions a little more closely than did the 160-acre group. Expected price and outlook-predicted-price correlated significantly in 1957 and 1958. Expected price was significantly associated in 1957, 1958, and 1959 with the actual price of the preceding fall, and in an inverse manner with the supply of hogs the previous fall.

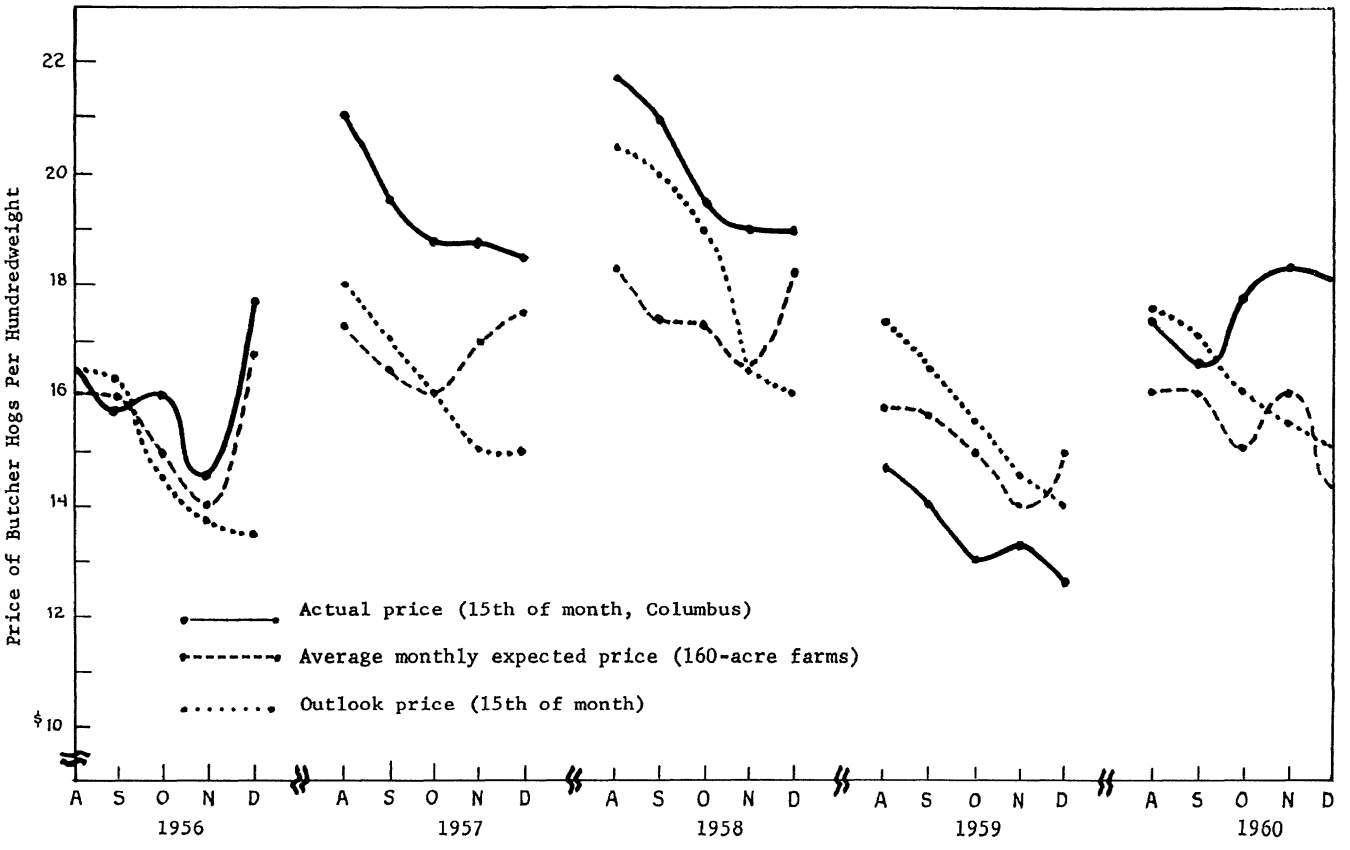
Of the various price predicting series tested, the price pattern for the previous fall would have served as the best predictor of actual price movements for the 320-acre operators to have followed during the

[3]The 1958 and 1959 correlations were significant at the 0.01 level. The 1956 association was significant at the 0.05 level.

[4]The association was significant at the 0.01 level.

[5]The r values for 1957 and 1958 were 0.39 and 0.49, which are statistically significant at the 0.05 probability level. The r value for 1959 was 0.74, which is significant at the 0.01 level.

Fig. 2.—Operators' Expected Prices, Prices Actually Received, and Outlook Prediction Prices for 190 to 220 Pound Butcher Hogs, 160-Acre Farms, August through December, 1956 to 1960



1957-59 period. The correlations were positive and significant at the 1-percent level for 1957, 1958, and 1959.[6]

Correlation of Various Price Series for Corn and Soybeans

The second investigation involved a correlation analysis to determine what price functions were related to actual and expected prices for corn and for soybeans during the 1957-60 period. The independent price series variables used were outlook price, actual price, actual price lagged one year, and the Commodity Credit Corporation support price. The correlation coefficients are shown in Appendices A-1 and A-2.

Actual corn price and the operators' expected prices for corn declined during the 1957-60 period. All variables, except CCC prices, showed positive and highly significant correlation with the expected prices of the 160-acre operators. For the 320-acre group expected prices correlated significantly with outlook prices and with the lagged actual price. Outlook-price predictions would have served as a basis for predicting price trends during the period of study, inasmuch as that series followed the actual price trend more closely than any of the other price variables used.

The expected soybean prices of both groups of operators were significantly correlated with actual price, with outlook predictions, and with the one-year price lag series. The outlook and the lagged series were about equally good as predictors of actual price trends over the period studied. There was no evidence that the farmers, as a group, patterned their expected prices for either soybeans or corn after the CCC support price movements for the four-year period studied.

Effect of Price Information Sources

We next investigated the influence of the number of sources of economic information to which the operator was exposed. Thirty-two 160-acre operators and twenty-six 320-acre operators were questioned as to their sources of price information. Their answers are summarized in Table I. Twenty-two of the 160-acre operators reported six or more sources of price information. Only 10 of the 320-acre farmers reported as many as six. We then correlated price prediction error[7] with number of sources of price information available. Apparently, the group of 160-acre operators gain very little from a greater num-

[6]The r values were 0.77, 0.72, and 0.72 respectively.

[7]Price prediction error was computed for each operator as the difference between his expected price of a farm product and the actual price he received, divided by actual price. Individual product errors were combined into an overall prediction error by weighting according to contribution to total income. Prediction errors ranged from 2.3 percent to 24.1 percent, with the mean errors of 11.16 percent and 11.01 percent for the 160-acre group and the 320-acre group, respectively.

TABLE 1.—Farm Operators' Sources of Price Information, 160-Acre Farms, 1956, and 320-Acre Farms, 1957.

Sources of Price Information	Thirty-two 160-acre farm operators		Twenty-five 320-acre farm operators	
	Number	Percent	Number	Percent
Farm Magazines	29	91	22	88
Newspapers	28	88	20	80
Radio and Television	27	84	20	80
News Letters	22	69	14	56
Neighbors	21	66	7	28
Farm Meetings	19	59	7	28
County Agent	18	56	8	32
Research and Extension Bulletins	12	38	11	44
Bankers	12	38	4	16
Local Buyers	10	31	2	8
Farm Management Publications	6	19	4	16
Vocational Agriculture Teachers	4	12	2	8
Soil Conservation Service	1	3	1	4

ber of economic information sources—the correlation coefficient was $r=0.244$, which was not high enough to be statistically significant at the 0.05 level. The correlation of number of price information sources on percent of prediction error for the 320-acre group, however, showed a definite relationship.[8] This indicates that for the 320-acre group the greater number of sources available, the less was the predictive error.

A follow-up question was later asked each operator as to what type of price information he considered most helpful in formulating his price expectations. Outlook information was declared to be most helpful by 31 percent of the 160-acre operators and by 42 percent of the larger farm operators. Much smaller percentages of the following were reported as helpful: (1) last year's price; (2)operator's past experience; (3) government support price levels; (4) the general economic situation; and (5) opinions of neighbors and local buyers.

The findings thus far in this report seem to indicate that the 320-acre operators depend more on outlook predictions than do the 160-acre operators. Respective accuracies of price prediction of the two groups are discussed in a later section.

Effect of Previous Year's Production on Expectations

In dealing with farmers' yield expectations for the coming year, we thought that perhaps an operator would adjust his expectation of crop yield, or of livestock birth rates, in the opposite direction of his previous year's yield expectations error. We tested this for expected

[8] $r=-0.395^*$ One asterisk denotes significance at the .05 probability level.

yields of corn, wheat, soybeans and oats.[9] All correlations were significant except for wheat on the 160-acre farms[10] and for oats on the 320-acre farms. The results give strong evidence that most operators do adjust their yield estimates according to last year's yield rather than basing their expectations on some normal or average yield. This type of prediction tends to accentuate cyclic expectation errors. The coefficients are shown in Appendix B.

We then tested to see if the same hypothesis would hold true for livestock birth rate estimates. We ran analyses on dairy calf-crop percentage and number of fall pigs per litter. Correlations were significant for litter size estimates for both farm size groups, and for estimates of dairy calf-crop percentages on the 160-acre farms. This suggests that the hog raisers tended to adjust their predictions according to litter size the preceding fall, and the 160-acre dairy farmers to adjust calf-crop expectation to last year's calf-crop percentage. These coefficients also are shown in Appendix B.

Further exploration revealed that the 160-acre operators also related fall litter size expectations to the number of pigs farrowed per sow in the spring.[11] This was not true for the 320-acre operators.

HOW ACCURATE ARE FARMERS' EXPECTATIONS?

The preceding correlations between expected values and various other variables are useful in determining relationship but they do not indicate the degree of conformity of farmers' expectations to actual realized values. To check correctness of estimates we ran a series of paired difference comparisons to see if the sample means of expectations were close enough to the sample means of actual prices, acreages and yields that we could say that both samples probably were drawn from the same large groups of price, acreages and yields.

Accuracy of Product Price Expectations

The prices farmers expected to receive for products they intended to sell during the year were compared with the actual prices they received when the products were sold. The products for which price differences were tested were corn, soybeans, oats, wheat, fat lambs, fat steers and heifers, and for fat butcher hogs sold between August 1 and

[9]We let X=(expected yield the previous year) minus (actual yield the previous year) and Y=(expected yield the previous year) minus (expected yield the coming year).

[10]Yield expectations were obtained from the cooperators in March, and the farmer thus had an opportunity to observe how well his wheat had come through the winter. This would help him to make a more accurate yield estimate.

[11]r=0.420** Two asterisks denote significance at the .01 probability level.

January 1. Each product was analyzed by farm-size group and by individual years. The "t" test of paired comparisons was used to determine significance of the price differences. The mean price differences for each product are shown, by years, in Appendices C-1 and C-2, with significance probability level of Alpha at .10 and with Beta limited to the .10 and .20 levels.[12]

On the 160-acre farms (Appendix C-1) it can be seen, for example, that the mean difference between the operators' expected selling prices of corn in 1956 and the prices they actually received when the corn was sold, was 15 cents per bushel. Thus the average expected corn price of the 160-acre operators who sold corn was 15 cents per bushel lower than the average selling price. This mean difference actually tested significantly large at the 0.01 level of probability. We conclude that in 1956 the 160-acre sample group of farmers, on the average, did not predict their selling price of corn with enough accuracy that we could depend on their price expectations to forecast the selling price of corn. You will note in Appendix C-1 that if we restrict the probability of a type II error to ten chances in 100 ($B=.10$) the probability of a type I error occuring is still less than 10 percent ($\alpha < .10$). Other values in Appendices C-1 and C-2 can be interpreted similarily.

By examining Appendix C-1 you can see that the 160-acre operators had six of 15 mean price differences for grain significant at the 0.10 level of Alpha when the power of the test was .90 or more. In these six instances, the probability is no more than one in ten that the observed differences were purely chance occurrences. We concluded that the 160-acre operators' price expectations for grain would be a poor predictor of actual grain prices.

The 320-acre group has 3 grain price differences testing significant at $\alpha=.1$ and $B=.1$. These farmers, as a group, apparently predicted better than the 160-acre operators, but we would still be hesitant to

[12]We hypothesized that each mean-price difference between expected and actual prices came from a population of price differences of which the mean was zero. If this were true, both expected and actual prices would be part of the same population of prices. In testing this null (no difference) hypothesis at, for example, the 0.01 probability level, we would reject the hypothesis when the probability is as low as one in 100 that so large a price difference could occur by chance when the expected and actual prices were really a part of the same population of prices. You can see that rejection at the 0.01 level minimizes the probability of discarding a true hypothesis. On the other hand, a higher probability level, such as 0.2 would lessen the probability of accepting a false premise but would increase the chance of discarding the hypothesis even if it were really true. We feel that loss could result if the operators either adjusted resources to an unreliable predictor, or failed to adjust to a reliable one. To safeguard against this we performed our tests of significance to provide 90 percent probability of eliminating both type I and type II errors ($\alpha=.1$ and $B=.1$). Appendices C-1 and C-2 show the significance designations of the mean differences at $\alpha=.1$ when the power of the test is .80 or above and also .90 or above.

accept a series of mean price differences in which nearly 1/3 of the cases had a 90 percent probability of expected prices being significantly different from actual prices.

Both size groups showed about the same lack of accuracy in predicting livestock prices, with over 40 percent of the mean price differences testing significantly different from zero difference. This indicates that the operators were poor predictors of both grain and livestock prices but the 320-acre operators predicted grain prices somewhat better than livestock prices.

Accuracy of Acreage and Yield Expectations

We next compared the farmers' crop acreage and yield expectations for corn, wheat, soybeans, and oats in the same way we had compared price expectations. The mean differences and significant error values for crop acreages and for crop yields are shown in Appendices C-1 and C-2.

The reader will note that only two acreage differences for the total number of sample operators test significantly different at the 0.10 levels of Alpha and Beta. These are the mean corn acreage reduction of 5.3 in 1958 and the 3.5 increase in the 1957 soybean acreage. These shifts were caused mainly by late spring or wet weather. The overall acreage disappearance on the 160-acre farms in 1959 was due to less rotation pasture being plowed up for crops. The crop acreage reduction in 1957 on the group of larger farms was caused by acreage being diverted into the soil bank. It seems evident that the sample operators were much more accurate in predicting actual acreage of grain crops than in predicting the prices at which the products would be sold.

The mean yield differences shown in Appendices C-1 and C-2 indicate that the yields expected by operators coincide very poorly with the realized actual yields in the extremely wet year of 1957. In 1956, 1958, and 1959, however, at $\alpha = .1$ only five of twenty expectations differed from actual realized yields when the test power was .80, and only three of twenty when the Beta probability was dropped to .10. It seems that if annual weather fluctuations could be minimized, the farmers' yield estimates would be good predictors of actual yields.

Accuracy of Livestock Sales Expectations

The farmers were asked to tell us how many of each kind of livestock they expected to sell during the coming year. Their expectations are compared with the number they actually did sell, and the results are shown in Appendices C-1 and C-2. None of the 18 mean differences

were significant when tested at the $\alpha = .10$ and $B = .10$ probability level. This suggests that these farmers' intentions were reliable enough to serve as a measure of the amount of livestock to be sold.

We also ran group comparisons on the number of sows the operators said they were going to farrow the following fall. The operators, as a group, predicted very well in 1956 and in 1958, but their errors were rather substantial for 1957 and 1959.

Reasons for Deviations of Actual from Expected

We asked the operators the primary reason for the deviation of actual realized values from preproduction expectations. The 160-acre operators and the 320-acre operators, as groups, gave the same order of importance to the various reasons advanced. In explaining the deviation in crop acreages planted, the following reasons were given, along with the percentage of operators giving that reason: (1) plans changed because of bad weather and field conditions (31.2 percent); (2) changed rotation or increased or decreased amount of grass (23.8 percent); and (3) operator's needs changed after expectation was given (20 percent). When asked the reasons for missing yield expectations, a large majority (75.2 percent) of those who had missed actual yield by more than five bushels per acre gave abnormal weather conditions as the primary factor. Another 11 percent attributed better yields to greater-than-expected benefits from increased fertilizer use or to response of improved seed varieties. Late seeding was blamed by another seven percent of the operators.

The explanation given by the cooperators for selling different amounts of grain than expected was bimodal in distribution. Nearly 46 percent of the operators replied that errors in their preproduction yield expectations were responsible for deviation in amount sold. Another 40 percent said that their needs changed during the year so that they either fed a different amount than they had expected, or decided to hold over until the next year, either as sealed or unsealed grain. Errors in livestock expectations were most commonly due to excessive death loss.

Price expectation errors were usually attributed by the operator to his failure to anticipate correctly the national supply of the product at his future selling date. About 62 percent of the operators gave that reason for deviation between expected and actual prices. Another 19 percent felt that low quality product, primarily wheat, had been responsible for their lower prices.

TABLE II.—Reasons for Deviations of Expected Crop Acreages from Previous Year's Crop Acreages, As Reported by Sample Farmers

Deviations due to:	160-acre operators Number	320-acre operators[1] Number
Irregular field sizes	21	8
Change in rotation, usually into or out of grass	18	16
Going into or out of acreage allotment	16	16
Substitute crop due to winter kill or late seeding	15	5

[1]Information applies only to a 3-year period. Information on 160-acre farms covers a 4-year period

Reasons for Deviations of Expected from Previous Actual

Where the operator's expectations for the coming year differed from his actual realized values of last year, we asked his reasons for the change. In explaining why their expected crop acreages differed from the actual acreage of the previous year, the operators gave several major reasons. These are listed in Table II.

Table II suggests a greater stability of operations on the 320-acre farms than on the 160-acre farms. The number and size of their fields seems to fit the rotation better. Their operations or available resources apparently permit them to reduce crop substitution necessitated by timeliness factors.

Both sample groups of farmers overwhelmingly listed an expectation of different weather conditions as the reason for predicting yields to be higher or lower than in the preceding year. Higher producing fields, more fertilizer, better seed, and better weed control were other reasons why some operators expected to improve yields for the coming year.

Errors of prediction of crop yield and livestock births, different crop acreage than originally expected, and changing needs for feed were the main reasons why the previous year's sales differed from the amounts of products the operators expected to sell during the current year. More death loss than anticipated was the reason given by several operators for failing to market as many animals the previous year as they expected to market in the current year.

Most operators had no real reason to explain why their expected prices for products to be sold differed substantially from the prices received the previous year. Expectation of greater or lesser total pro-

duction in the economy was the reason advanced by most, but several believed inferior quality of product had caused a lower price the preceding year.

Probabilities of Receiving Expected Hog Prices

After examing the price expectations of the operators, and reviewing the prices they received, we decided to find out the probabilities these farmers had of predicting hog prices within $1.00 per hundredweight of the actual hog prices in the month the operator intended to sell his hogs. We used expected prices of spring hogs to be sold in the fall as our sample. The daily prices for 190 to 220 pound butchers for September through December, 1956 through 1960, were plotted. On the same graphs were plotted the operators' expected prices as of the fifteenth of that month in which they intended to sell the greatest numbers of hogs. We thus assumed a flexibility of two weeks in selling date for the seller. We counted the number of marketing days during the month on which the price was within $1.00 per hundredweight of the operators' expected price. We did this for each operator for each month in the September-December period and summed the number of days falling within the ∓$1.00 range of expected price. This was divided by the product of the number of operators expecting to sell during a given month times the number of marketing days in that month. This answer represented the average probability of a seller obtaining a price within $1.00 per hundredweight of his pre-production price expectation for a given September-December period. We performed this analysis for each September-December period from 1956 through 1960, and also computed the average probability for the fall marketing months for the entire 5-year period. The 160-acre operators had an average probability of 0.526[13] for 1956 but only 0.173 in 1960. The 5-year average was 0.318. The 320-acre operators had a 0.498 probability in 1959 and only 0.208 in 1957. Their 4-year[14] average was 0.330. The difference between high and low market price within each month ranged from $0.75 to $3.25 over the 5-year period, with a mean range of $1.64 and a standard deviation of $0.60.

These probabilities indicate that, over the period studied, these farmers as a group had an average chance of about one in three to obtain a per-hundredweight selling price within a dollar of their expected hog prices.

[13]Where 1.0 is certainty, or 100 percent chance of success.

[14]Only 1957 through 1960 data were obtained for the 320-acre farms.

Consistency of Price Prediction

To learn whether price prediction accuracy was randomly distributed, or whether some operators were consistently better predictors than others, we computed hog price prediction error in cents per hundredweight for each operator for each of the years 1957, 1958, and 1959. To test the consistency of hog price prediction accuracy of operators from year to year, we correlated the price prediction errors between years. There was a significant relationship ($r=0.5595^*$) between 1957 and 1958 among the 160-acre operators, but no significant correlations in any other 2-year comparison. There was no evidence of relationship in any of the yearly comparisons for the 320-acre farm group. We concluded from this that during the 1957-1959 period the more accurate price predictors in one year are not necessarily the more accurate price predictors in any other year. To further test randomness of good and poor predictors, we computed intra-class correlations within the good and poor predictor groups.[15] Again the results were negative. Over time, price prediction accuracy for our sample of operators seems to be random. Tests on corn and wheat price prediction accuracy gave the same answers.

We then tested to see if good predictors of price for the major enterprise products were also good price predictors of products for the other enterprises on the same farm in the same year. The results were negative. The correlation coefficients were too low to give any evidence that operators who made good price predictions for one farm product would probably predict well for other products.

Group comparisons were used to determine whether or not the good predictors of hog prices were also better predictors of corn yields, corn acreage, soybean acreage, and number of spring hogs sold in the fall. No statistically significant difference was found for any of the variables tested for either the 160-acre or the 320-acre group.

Group comparisons were run between the good and poor price predictors for such characteristics as age, education, number of years experience in farming, quality of farm land, and operator's labor income. The results suggest that on the 160-acre farms the more accurate predictors are slightly younger and have been farming a shorter time. It also suggests, however, that they have slightly less education, about the same quality of farm and about $350 more labor income than the less

[15]A price error index value was computed for each operator for 1957-1959. This index was derived by weighting each individual commodity price error percentage by the importance of the particular enterprise to the operator's gross farm income. The operators were arrayed according to size of price error index, and the top half and bottom half formed the two groups.

accurate predictors. Years of farming experience tests significantly different at the 0.05 probability level. In the 320-acre group the good predictors had about two years more education than the poor predictors. This difference is significant at the 0.05 level. The good predictors appeared to be operating the better quality farms and their labor income averaged over $2,500 higher than the mean of the group of less accurate predictors.[16]

HOW CLOSELY DO FARMERS ADJUST THEIR PRODUCTION AND FARM ORGANIZATION TO THEIR PRICE EXPECTATION FOR THE COMING YEAR?

Two approaches were used to study operators' production response to expected price changes. The first was to question the sample farmers as to what crop and livestock adjustments they would expect to make with given product price relationships. The second approach was to test for relationships between operators' own expected price changes and the production adjustments they actually expected to make on their farms during the succeeding production period.

Operators' Expected Adjustments to Given Product Price Relationships

In the spring of 1960, each operator was asked how much of a particular product he would produce at each of several prices for that product, assuming that all prices other than that of the given product would remain at the 1959 level. He was also to assume no support prices and no acreage allotments. We said nothing to the operator about nonprice conditions with the thought he would then answer the questions within the framework of his own set of nonprice influences. These questions were mailed, along with explanations, to the operators two weeks prior to the enumerator's visit, so that each cooperator had been given an opportunity to think over his probable action. The results are shown in figures 3 through 7.

The graphs of the expected responses to various product price levels take the general form of increased production according to increased price, but at diminishing rates of change. Various obstacles, or rigidities, prevent a straight line, or constant rate of change. In the crop acreage functions, the primary obstacle is the tenacity with which most operators cling to a somewhat fixed rotation. Amount and fixity of resources, as well as personal preference, appear to influence the dairy and beef operators. Hog production seems most flexible and somewhat more constant in rate of change.

[16]This difference is not statistically significant at the 0.05 level. The standard deviation of labor incomes on these farms is $4,143.

Relationship Between Expected Price Changes and Actual Production Adjustments

Simple correlation[17] analysis was used to investigate whether or not the sample operators expected to produce more or less of a certain product as they expected the price of that product to be higher or lower than in the preceding year. The independent variable was: X = (expected price of corn in year A) minus (expected price of corn in year A + 1). We used the difference in the operators' *expected* acreage of corn between two successive years as the Y variable, rather than the difference between the actual acreages. It has been shown previously (page 13 and Appendices C-1 and C-2) that there seems to be very little real difference between operators' expected crop acreages and subsequent actual acreages. This method also tends to show the real acreage changes to price in the minds of the operators and to minimize whatever effect nonprice influences might have had between planting time and the date the operator gave his expectations.

The resultant correlation coefficient was much too small to suggest any association between the operators' expected changes in corn price and changes in corn acreage. This is consistent with the fact that when questioned as to reasons for year to year changes in crop acreages, no operator attributed corn acreage change to change in corn price.

To check possible relationship of soybean and corn acreage substitutions with operators' expected price changes we computed the correlation coefficients where X = (expected soybean price relative to corn price[18] in year A) minus (expected soybean price relative to corn price in year A + 1) and Y = (expected acreage of soybeans in year A) minus (expected acreage of soybeans in year A + 1). The r values were too small for both the 160-acre and 320-acre groups to give any evidence that price-relationship changes were associated with adjustment through substitution of corn and bean acreage.

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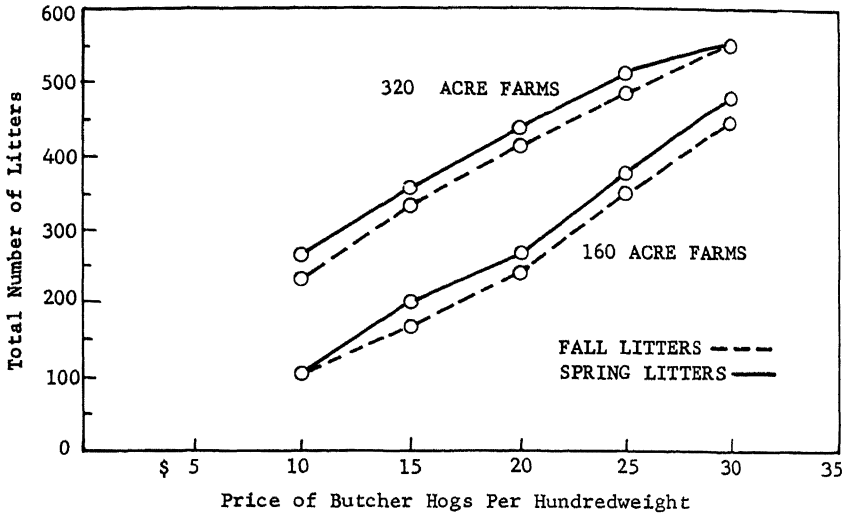
[17]The authors are aware that production adjustment may be due to the combined influence of several variables, and that to isolate a true or "net" influence of a certain independent variate on the dependent variate requires the derivation of partial correlations. The net effect, however, probably has less value than gross influence in this particular analysis because the operators cannot derive partial relationships and thus are more likely to act according to gross association. We also assume the sample to be representative of the population in all relationships. If association exists, for example, between the acreage of corn to be planted and a complex of influences surrounding, and including operators' expected selling price of corn, we assume this complex to be the same in the population. Thus, if the relationship between operators' expected selling price of corn and expected corn acreages is found to be significant we say that this complex could have been used as a predictor of expected corn acreage over the period under study.

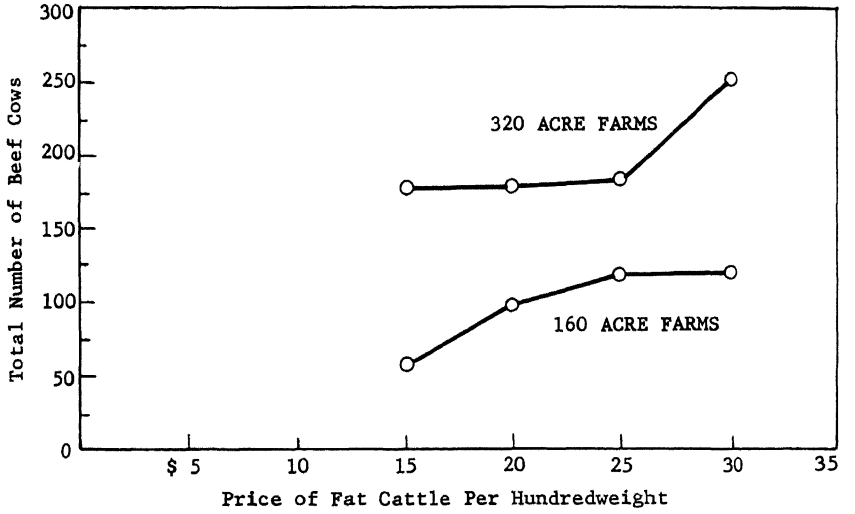
[18]The "relative price" of soybeans was computed by dividing soybean price by corn price.

Fig. 3.—Sample Operators' Stated Adjustment of Total Sow Numbers to Various Butcher Hog Prices[1]



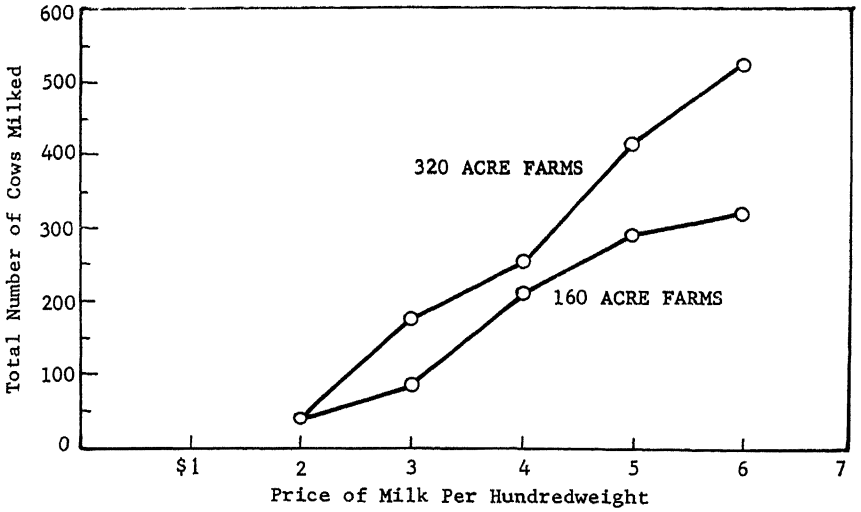
[1]These are numbers which the operators said they would raise during 1960 at various guaranteed prices of butcher hogs, with all other prices and costs guaranteed at 1959 levels.

Fig. 4.—Sample Operators' Stated Adjustment of Total Beef Cow Numbers to Various Fat Cattle Prices[1]



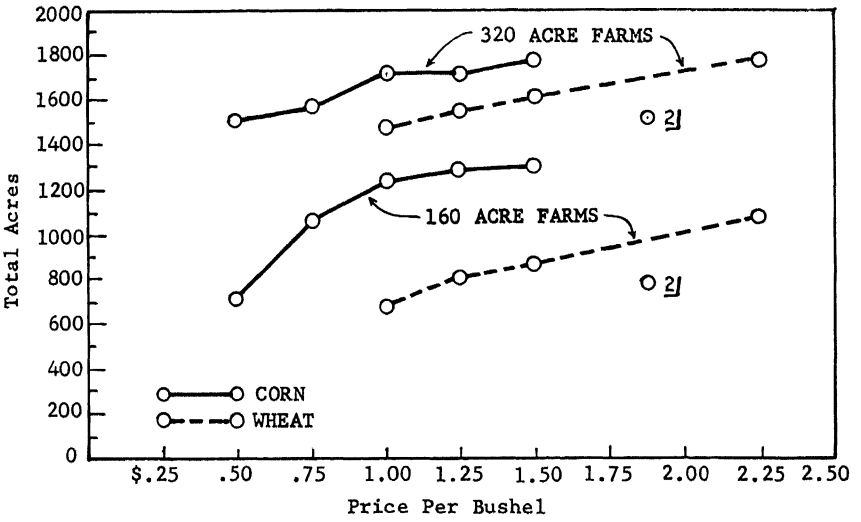
[1]These are numbers which the operators said they would raise during 1960 at various guaranteed prices of fat cattle, with all other prices and costs guaranteed at 1959 levels.

Fig. 5.—Sample Operators' Stated Adjustment of Total Cows Milked to Various Prices of Milk[1]



[1]These are numbers which the operators said they would milk during 1960 at various guaranteed prices of milk, with all other prices and costs guaranteed at 1959 levels.

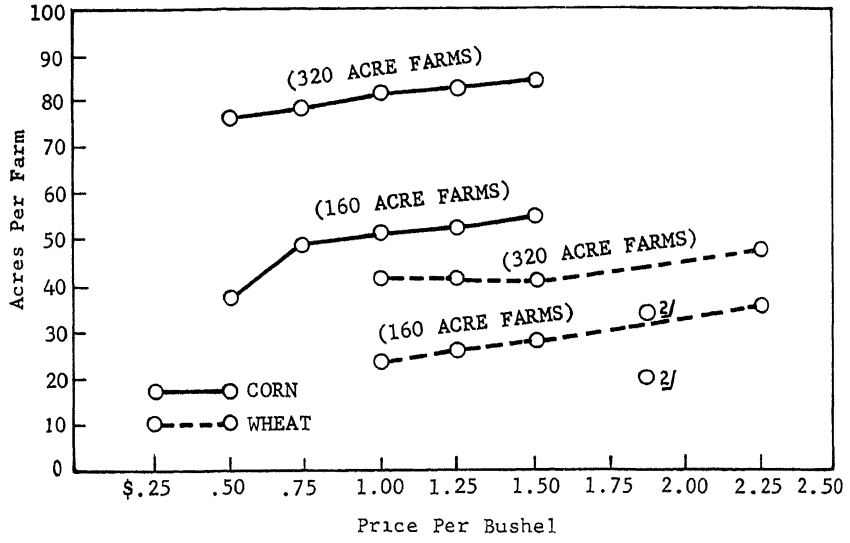
Fig. 6.—Sample Operators' Stated Adjustment of Total Acreage of Corn and Wheat to Various Price Levels[1]



[1]These are acreages the operators said they would raise during 1960 at various guaranteed prices of corn and wheat, assuming no wheat allotment and with all other prices and costs guaranteed at 1959 levels.

[2]Actual 1960 wheat acreage under acreage controls.

Fig. 7.—Sample Operators' Stated Adjustment of Average Corn and Wheat Acreage to Various Price Levels[1]



[1]These are acreages the operators said they would raise during 1960 at various guaranteed prices of corn and wheat, assuming no wheat allotment and with all other prices and costs guaranteed at 1959 levels

[2]Actual 1960 wheat acreage under acreage controls

We selected the hog enterprise, the largest livestock income source on most of the farms, to test the operators' production response to changes in expected prices of livestock.[19] The correlation coefficients were much too low[20] to suggest that these groups of farmers significantly adjust the number of spring litters to their expected butcher hog prices the following fall.

Determining Adjustments by Programming

To test whether adjustment to expected prices might be profitable, a linear programming model was formulated using a typical 160-acre livestock farm which was set up from a group of modal farms in the sample, and using the production coefficients used by the modal farms. The resource adjustment alternatives and restrictions are shown in Appendix D-1. The program was run using the operators' expected pro-

[19]The variables used were X = (expected price of hogs sold in the fall of year A) minus (expected price of hogs to be sold in the fall of year A + 1) and Y = (expected number of sows farrowed in spring of year A) minus (expected number of sows farrowed in spring of year A + 1)

[20]With N = 51 and 39 their values were —0 149 and —0 025 for the 160 acre and 320 acre farms, respectively

duct prices in 1957. Had the resources been reallocated to maximize returns to expected prices, the livestock enterprise combination would have been:

18 sows in a 2-litter system
16 beef feeder steers
540 laying hens

The actual livestock enterprise combination in 1957 was:

15 sows in a 2-litter system
18 beef feeder steers
150 laying hens

The adjusted organization provided for the purchase of about 450 bushels of corn and 650 bushels of oats and the sale of 360 bushels of wheat and 11 tons of hay. The actual organization needed the purchase of 400 bushels of corn and 200 bushels of oats. About 400 bushels of wheat were sold.

The differences between the two organizations do not seem very significant, but had the operator adjusted to his price expectations, he would have received $2,264, or about $460 more net income, under the realized prices that year, at no increase in capital requirements (see Appendix D-2).

Effect of Adjustment On Income On a Sample Farm

To further examine the effectiveness of adjustments to expected prices we selected a representative farm from among the 160-acre hog farms in the sample. The operator's fixed and variable costs and his hog production coefficients were estimated. The cost curves, including marginal cost, were derived. This operator had a cost of $13.00 per hundredweight at the lowest point on the average variable cost curve. We computed the incomes the operator would have received had he adjusted sow numbers to each of several expected prices, but sold his hogs at a price of $18.50. Changes of only one or two sows were accompanied by only small changes of income. In those cases where inputs must be made in large units or where the farm is already being operated at a point near some average additional-cost = additional-returns position, the operator would not bother to adjust unless the expected price change were substantial.

Influence of Nonprice Factors in Decision Making

In an attempt to uncover other possible obstacles to adjustment to price we asked each operator to tell us how often, in terms of "never," "occasionally," or "frequently," he decided not to invest in what he

thought would be a more profitable production alternative solely because of some specific nonprice factor. We suggested several such factors and recorded the answers. These questions were asked on the fifth and sixth visits, so substantial rapport had been established with the cooperator.

The nonprice factors named by the 160-acre operators as frequently affecting their decisions, in order of percentage of operators influenced, are: (1) lack of sufficient knowledge of probable returns from the action, 80 percent; (2) reluctance of operator to give up a portion of leisure time, 63 percent; (3) competition between the farm and the home for production resources, 60 percent; (4) operator's aversion to borrowing capital, 55 percent; and (5) additional returns offset by personal preference of operator, 50 percent.

The 320-acre operators generally agreed on the same factors, but in a somewhat different order of importance.[21] Their responses were: (1) additional return offset by personal preference of operator, 75 percent; (2) reluctance of operator to give up a portion of leisure time, 58 percent; (3) operator's aversion to borrowing capital, 58 percent; (4) lack of sufficient knowledge of probable returns from the alternative, 53 percent; and (5) wife's opinion differs from operator's on choice of action, 53 percent.

A majority of the cooperators in both farm size groups replied negatively on such influences as: (1) age of operator; (2) health of operator; (3) education of operator; (4) risk of low yields or low prices; and (5) inability to obtain adequate capital. Fourteen of 18 operators farming in partnership with, or renting from, relatives reported disagreements with partner or owner as being an obstacle to adjustment.

The evidence is strong that many farmers make their business decisions within a framework which includes influences commonly referred to as "noneconomic."[22] With the large number of these intangible influences, and the varying degrees of intensity which each can assume, it seems almost certain to the authors that they supplement, and perhaps dilute, a monetary profit-maximization effort by farm operators.

[21]No effort was made to determine significant differences between farm size-groups for any given factor influence. Our primary interest was in the difference between zero operators and the number who reported being influenced by the factor. All the percentages reported here are obviously sufficiently high to be statistically different from zero.

[22]The authors prefer to call these "economic intangibles" inasmuch as want-satisfaction can take place as fluently as with acquisition of material goods, and these nonprice factors seem to complete activity with price and cost influences in economic decision making.

CONCLUSIONS

The sample operators generally did not seem to rely very heavily on established price series functions to aid them in formulating product price expectations. Price received the previous year and current price at the time expectations are made seem to influence the operators about as much as outlook-price information, and more than the other series tested. Yield and birth rate predictions are closely related to the production rates of the previous year. The operators show a knowledge of seasonal price movements and an awareness that supply seems to govern prices. Very few of these operators, however, think in terms of consumer demand.

Operators participating in the study are fairly reliable predictors of crop acreage and number of livestock to be sold but not of yields or prices. The price-prediction accuracy of these farmers appears to be randomly distributed over time and between the different products.

Farmers' declared expectations are not a dependable indication of their adjustment of a farm organization or production. The operators say they would make certain production responses to changing price relationships but examination of their actual responses to their own expected price changes reveals considerably less adjustment. The small amount of adjustment actually made to price expectations suggests that noneconomic considerations influence operators more than do moderate price changes.

Our investigations indicate that obstacles to adjustment to the operators' expectations fall into 2 broad categories. These are economic and noneconomic. In the sample groups one or more of the following economic reasons generally accounted for the operators' failure to adjust:

1. The operator was not sure enough of his prediction accuracy to make a move. He retained what he considered a "middle of the road" position.
2. The operator did not have control of sufficient resources to effect a proper change, and most operators admitted an aversion to borrowing money as a deterrent to adjustment.
3. The operator lacked precise knowledge of the input-output transformation function of alternatives, which frequently caused him to take no action.

4. Many operators had found from experience that their particular cost structure was such that changes in resource allocations in response to moderate price changes do not increase income sufficiently to stimulate effort to adjust.

The most common noneconomic impediments to adjustment to expectations were: (1) the operators' preference; (2) his desire for leisure time; and (3) the competition of the household for funds which could profitably have been invested in the farm business. These influences prevented consistency with monetary maximization principles.

If farmers' objectives are to maximize total want satisfaction rather than to maximize monetary returns, either annually or over time, production responses to expected or actual price changes may appear unstable, erratic, and nonmeaningful when evaluated within the framework of conventional maximization economics. Voluntary internal rationing of capital, time, and personal preferences appear to be important in decision formulation. It is necessary to quantify these variables if they are to be included in equations of supply or production response.

The present study was made with the hope of uncovering various indications which might be of value in directing research in this area of production response motivation. We feel that carefully designed studies should integrate current investigations of profit maximization and the human factors of labor and management in agriculture. If these nonmaterial influences affect operators' production responses as much as appears to be true from our study, it will be necessary to measure them and include them when deriving predictive response equations of agricultural production.

APPENDIX A - 1

Correlations of Operators' Expected Price With Various Price and Supply Functions, by Products, 160-Acre Farms

Item	Hog price					Corn price	Soybean price
	1956	1957	1958	1959	1960	1957 - 1960	1957 - 1960
Expected price correlated with:							
Outlook price	0.05	—0.01	0.59**	—0.09	0.01	0.62**	0.63**
Actual price	0.41*	0.16	0.52**	0.72**	—0.02	0.61**	0.53**
Actual price 1 year earlier	—0.01	0.15	0.31	0.40	0.04	0.56**	0.71**
Actual price 6 months earlier	—0.05	—0.16	—0.68**	0.59**	0.13	——	——
Supply 1 year earlier	0.02	—0.09	—0.59**	—0.37	—0.13	——	——
CCC price	——	——	——	——	——	0.23	0.17

*Significant at the 0.05 level.
**Significant at the 0.01 level.

APPENDIX A - 2

Correlations of Operators' Expected Prices With Various Price and Supply Functions, by Products, 320-Acre Farms

Item	Hog price				Corn price	Soybean price
	1957	1958	1959	1960	1957 - 1960	1957 - 1960
Expected price correlated with:						
Outlook price	0.60**	0.57**	0.40	0.31	0.59**	0.64**
Actual price	0.23	0.62**	0.65**	—0.38	0.34	0.56**
Actual price 1 year earlier	0.43*	0.54*	0.60**	0.24	0.64**	0.53**
Actual price 6 months earlier	— .44*	— .43	.20	— .32	——	——
Supply 1 year earlier	— .53*	— .57**	— .49*	— .37	——	——
CCC price	——	——	——	——	27	.25

*Significant at the 0.05 level.
**Significant at the 0.01 level.

APPENDIX B

Relationship of Operators' Production Expectations to Difference Between Expectations and Performance of Previous Year, 160-Acre and 320-Acre Farms, 1956-1960[1]

	160-Acre farms	320-Acre farms
	(r)	(r)
Corn yield	0.369**	0.509**
Wheat yield	.215	.295*
Soybean yield	.645**	.521**
Oat yield	.471**	.445**
Dairy calf crop	.374**	.085
Fall pigs per litter	.343*	.455**

[1]Data on 320-acre farms apply only to 1957 - 1960.

*Significant at the 0.05 level.

**Significant at the 0 01 level.

APPENDIX C - 1

Tests of Significance of Operators' Expectations Minus Realized Values of Price, Acreage, Yield, and Amount Sold of Various Commodities, 160-Acre Farms, by Year[1]

Item	Unit	Year 1956	1957	1958	1959
Mean price differences per farm:					
Corn[2]	$/bu.	—0.15**	— 0.05*	— 0.06	— 0.01
Soybeans	$/bu.	.08	— .02	.05	— .14**
Oats	$/bu.	— .09**	— .07**	— .02	——[3]
Wheat[2]	$/bu.	.01	.02	.16**	— .11**
Lambs	$/cwt.	— .82	— .43	— .61	.64
Fat cattle	$/cwt.	—1.74*	— 2.73**	— 3.88**	— .71
Market hogs	$/cwt.	— .76*	— 2.22**	— 1.66**	1.71**
Mean acreage differences per farm:					
Corn	acre	0.1	0.6	— 1.5	1.0
Soybeans	acre	—0.1	— 3.5**	— 0.6	0.4
Oats	acre	0.8	1.1	2.0	1.9
Wheat	acre	—0.1	— 0.2	0.4	0.6
Mean yield differences per farm:					
Corn	bu./a	2.1	11.3**	19.0**	9.7**
Soybeans	bu./a.	5.3*	0.2	2.6	0.7
Oats	bu./a.	—0.1	15.3**	— 5.7*	5.5
Wheat	bu./a.	1.0	1.6	— 1.2	1.6
Mean differences of L. S. sold per farm·					
Lambs	lamb	—4.9	1.6	8.2*	——[3]
Fat cattle	head	0.8	1.5	0.4	——[3]
Spring hogs	hog	5.0	5.7	7.9	16.4*
Mean differences per farm in number of sows fall-farrowed	sow	1.8	3.3**	0.9	3.4*

[1]The "t" test (mean difference ÷ standard error of mean difference) was used to determine the significance of the variation of realized value from expected values. (Farmers not participating in an activity are not included when deriving a mean for that activity.)

[2]Includes grain sold to Commodity Credit Corporation.

[3]Too few cases to be statistically meaningful.

*Significant difference at $\alpha = .10$ and power of test $= .80$ or more ($B = .2$).

**Significant difference at $\alpha = .10$ and power of test $= .90$ or more ($B = .1$)

APPENDIX C - 2

Tests of Significance of Operators' Expectations Minus Realized Values of Price, Acreage, Yield, and Amount Sold of Various Commodities, 320-Acre Farms, by Years[1]

	Unit	Year 1957	1958	1959
Mean price differences per farm:				
Corn[2]	$/bu.	0.04	—0.02	0.03
Soybeans	$/bu.	— .07*	.00	— .12**
Oats	$/bu.	— .01	— .05	— .01
Wheat[2]	$/bu.	02	13**	— .12**
Lambs	$/cwt.	— 1.00	60	1.14
Fat cattle	$/cwt.	— 1.85**	—1.59**	—1.05*
Market hogs	$/cwt	— 2.26**	—2.21**	19
Mean acreage differences per farm:				
Corn	acre	.9	5.3**	—1.6
Soybeans	acre	1.9	—5.1	—0.5
Oats	acre	2.6*	—0.4	1.6
Wheat	acre	2	—0.9	0.8
Mean yield differences per farm:				
Corn	bu./a.	9.6**	9.8**	4.9
Soybeans	bu./a.	2.5	1.8	1.6
Oats	bu./a.	15.6**	—1.6	—3.8
Wheat	bu./a.	2.9**	—1.6	1.9
Mean differences of L. S. sold per farm:				
Lambs	lamb	7.4	0.8	——[4]
Fat cattle	head	0 8	0.1	—1.9
Spring hogs	hog	15.9	0.7	5.5
Mean differences per farm in number of sows fall-farrowed	sow	1.8	—0.4	2.1**

[1]The "t" test (mean difference ÷ standard error of mean difference) was used to determine the significance of the variation of realized values from expected values. (Farmers not participating in an activity are not included when deriving a mean for that activity).

[2]Includes grain sold to Commodity Credit Corporation.

[4]Too few cases to be statistically meaningful.

*Significant difference at $\alpha = .10$ and power of test = .80 or more ($B = .2$).

**Significant difference at $\alpha = .10$ and power of test = .90 or more ($B = .1$).

APPENDIX D-1: Linear Programming Matrix Showing Resource Use, Alternatives and Restrictions, Typical 160-Acre Livestock Farm. Optimized to Operators' Expected Prices, 1957.

Kind of resources available	Unit	Amount of resources, Jan. 1. '57		Two lit. hogs (sow)	Spr. hogs (sow)	Fall hogs (sow)	Beef strs. (str)	Poultry (hen)	Rotation (12.8A)	Perm. past. (A)	Buy corn (bu)	Sell corn (bu)	Buy oats (bu)	Sell oats (bu)	Buy hay (ton)	Sell hay (ton)	Sell wheat (bu)
Cropland	Acre	128	1/						12.8								
Corn	Bu.			205.0	112.0	120.7	45.0	.53	-425.0		-1.0	1.0					
Wheat	Bu.							.25	-49.6								1.0
Oats	Bu.			50.0	35.0	33.7	5.0	.28	-47.2				-1.0	1.0			
Hay	Ton			.1	.1	.07	.8	.005	-2.85						-1.0	1.0	
July rot. pasture	A.U. Day			17.1	16.7	6.4	22.5		-60.8	-7.0							
Permanent pasture	Acre	11								1.0							
Capital	Dol.	13205		337.10	248.46	259.54	81.06	3.29	283.90	3.33	1.19		.75		18.00		
April labor	Hour	373		3.5	3.5	1.1	.5	.3	10.14								
October labor	Hour	405		6.5	2.3	3.3	2.5	.2	13.99								
Feb. livestock space	Sq.Ft	3350		96.2	16.2	96.2	18.0										
Net income (CJ)	Dol.			325.65	159.96	148.54	107.89	1.64	-393.34	-3.50	-122	1.18	-.77	.62	-18.45	18.00	1.97

1/ Dis-use vectors not shown.

APPENDIX D-2: Family Labor Earnings When Actual Product Prices Received in 1957 Are Applied to the Optimum Farm Organization Derived From Matrix Shown in Appendix D-1.

Activity	Unit	Optimum Amount	Total Feed Used and Produced *				Resources Used					Income	
			Corn	Oats	Wheat	Hay	Capital	Rot. Pasture	April Labor	Oct. Labor	L.S. Space	Per Unit	Total
			(bu.)	(bu)	(bu)	(Ton)	($)	A.U. Days	Hour	Hour	Sq.Ft.	$	$
Hogs (2-Litter)	Sow	18	3690	900		1.8	6068	308	63	117	1732	400.55	7217
Beef Steers	Str.	16	720	80		12.8	1531	360	8	40	288	110.84	1773
Poultry	Hen	540	286	151	135	2.7	1777		162	108	1/	1.90	1026
Sell wheat	Bu.	361										1.92	693
Sell hay	Ton	11										16.50	185
Buy corn	Bu.	446.					602					-1.39	-620
Buy oats	Bu.	659					474					-.74	-488
Cropland used	Acre	128	4250*	472*	496*	28.5*	2839	608*	101	140		-30.73	-3933
Perm. Past. used	Acre	11					37	77*				-3.50	-38
Resources not used							-125	17	39		1330		
Less hired labor available but not used									32				
Net resources unused							-125	17	7		1330		

* Items produced are marked with an asterisk; those used are not so marked.

1/ Poultry housing was special and not included in "February livestock space."

Value of house rental and garden	625
TOTAL FARM EARNINGS	6440
Fixed cost on land, bldgs., mach.	3987
Cost of October hired labor	64
Less capital deficit	125
FAMILY LABOR EARNINGS	2264